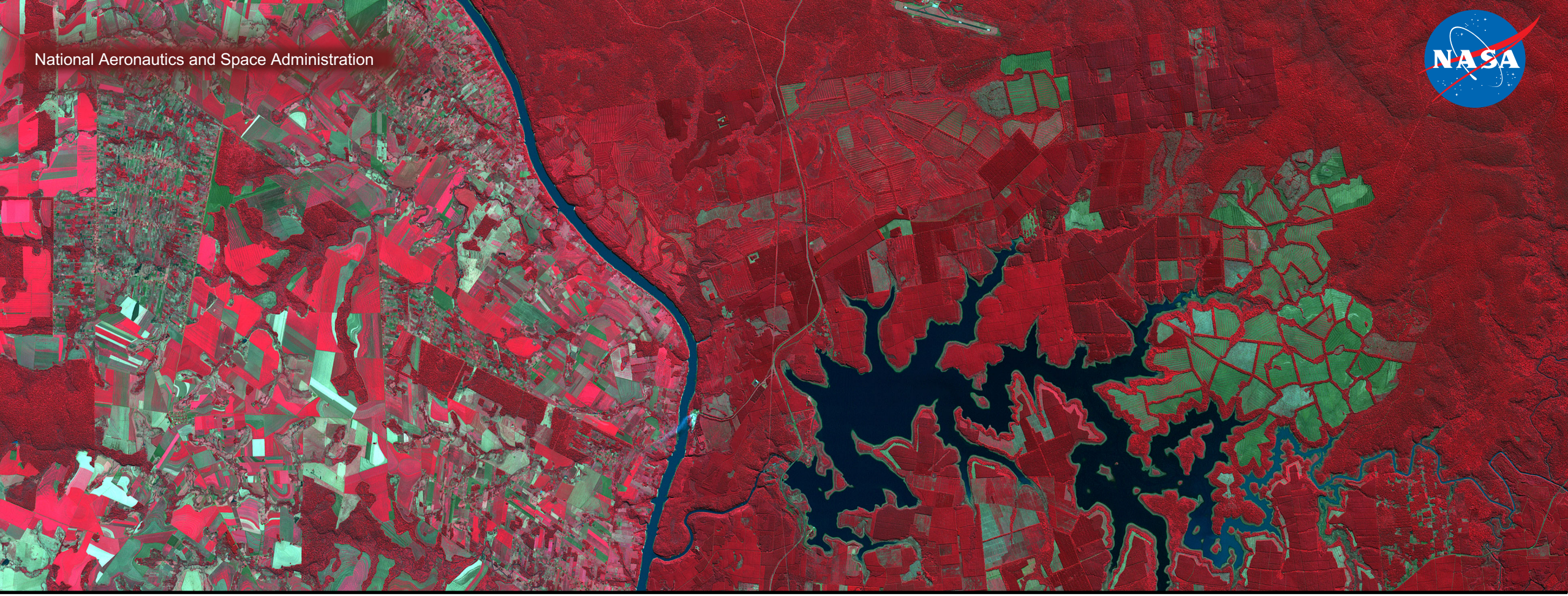

Access & Analysis of MODIS NDVI Over the Sao Francisco Verdadeiro Watershed

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1 December 2017

Objectives

By the end of this exercise, you will be able to download and analyze NDVI (Normalized Difference Vegetation Index) over the SFV watershed and examine inter-annual differences

Requirements

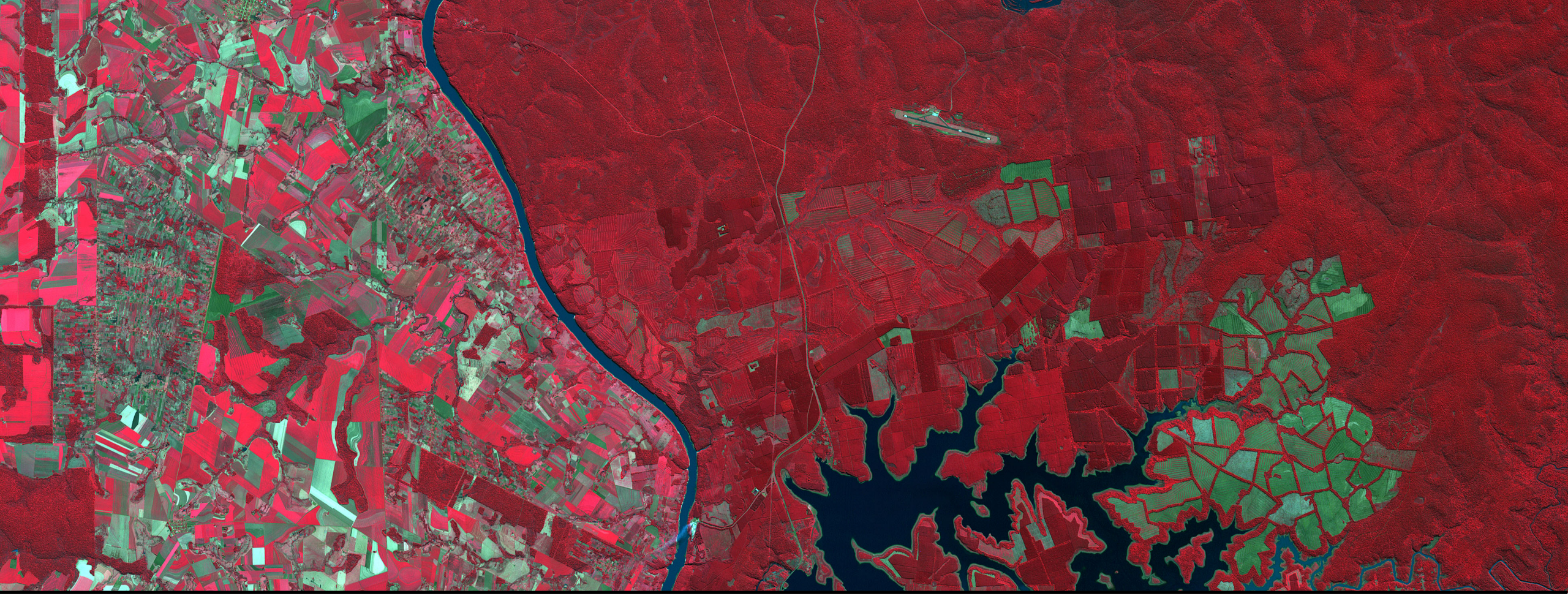
- QGIS installed on your computer
  - https://arset.gsfc.nasa.gov/sites/default/files/water/drought/Introduction%20to%20QGIS.pdf
- A shapefile for the Sao Francisco Verdadeiro watershed saved on your computer
  - http://arset.gsfc.nasa.gov/
- NASA Earthdata Account

Outline

- Part 1: Search and Download MODIS NDVI Data
- Part 2: Analyze Inter-Annual Differences in NDVI using QGIS

Note

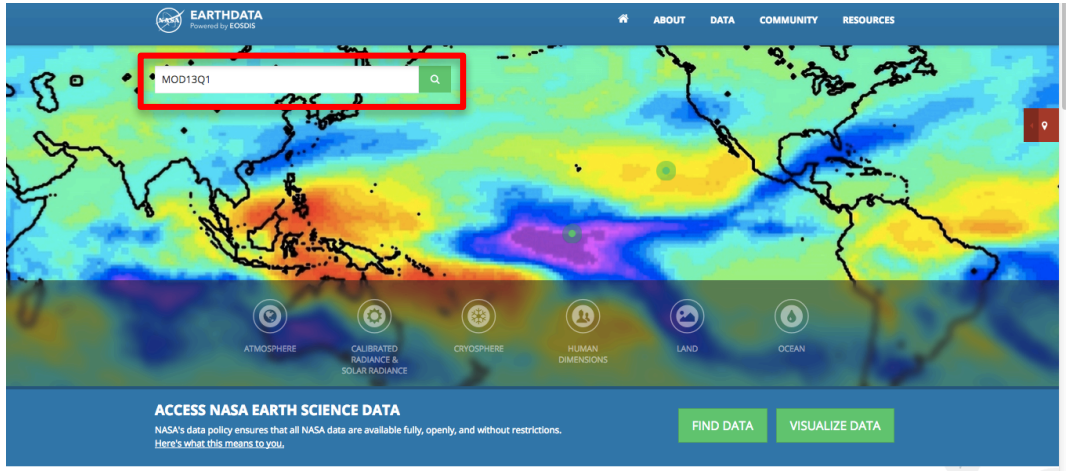
- We will be analyzing MODIS NDVI product from Terra, MOD13Q1 Version 006
  - https://lpdaac.usgs.gov/dataset_discovery/modis/modis_products_table/mod13q1
- MOD13Q1 has spatial resolution of 250 m and temporal resolution is 16 days
- The NDVI values vary from -1 to 1, where negative to 0 indicate no vegetation and 1 indicates maximum vegetation

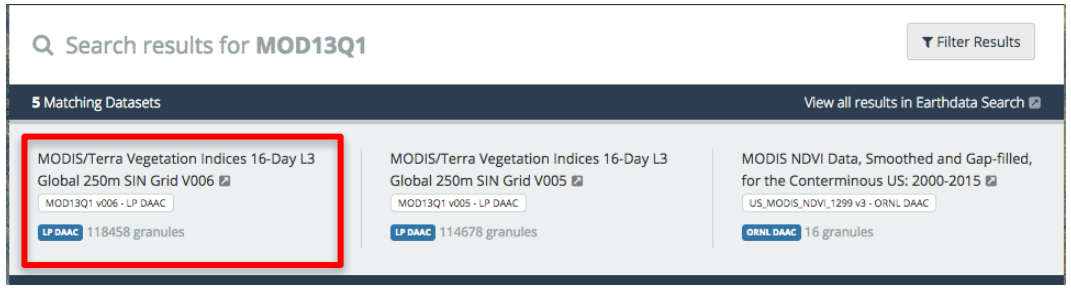


Part 1: Search and Download MODIS NDVI

Search and Download NDVI Data

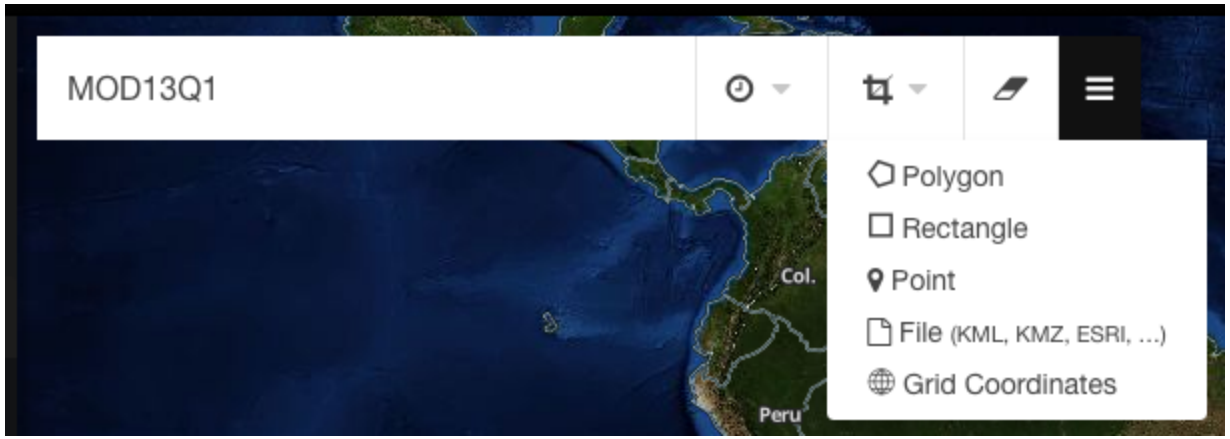
1. On your computer make a folder named **NDVI**
2. Go to https://earthdata.nasa.gov/
3. In the Earthdata search window enter MOD13Q1 and click on the looking glass next to the window
4. You will get a list of products under **Search results for MOD13Q1**
5. Click on **the MODIS/Terra Vegetation Indices 16-Day L3 Global 250m Sin Grid V006** product
6. You will see **Earthdata Login** button at the top right to login to your account

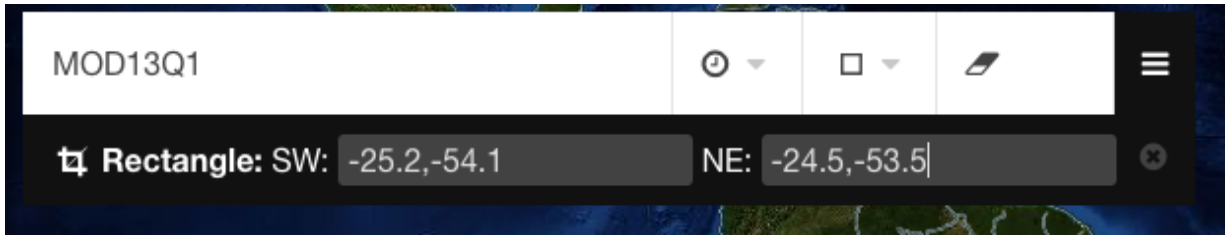




Search and Download NDVI Data

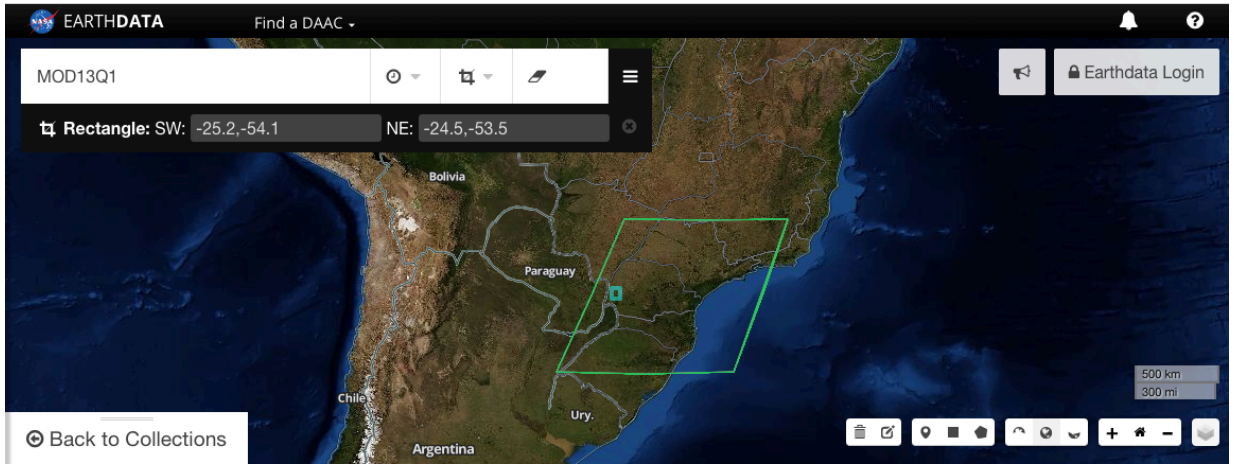
7. Use your mouse to scroll over Brazil
8. In the **Search** bar at the top, type in **MOD13Q1**
9. Click on the **Spatial Subset icon**, select **Rectangle**, enter the latitude and longitude coordinates close to the SFV watershed
   - SW: -25.2,-54.1
   - NE: -24.5,-53.5

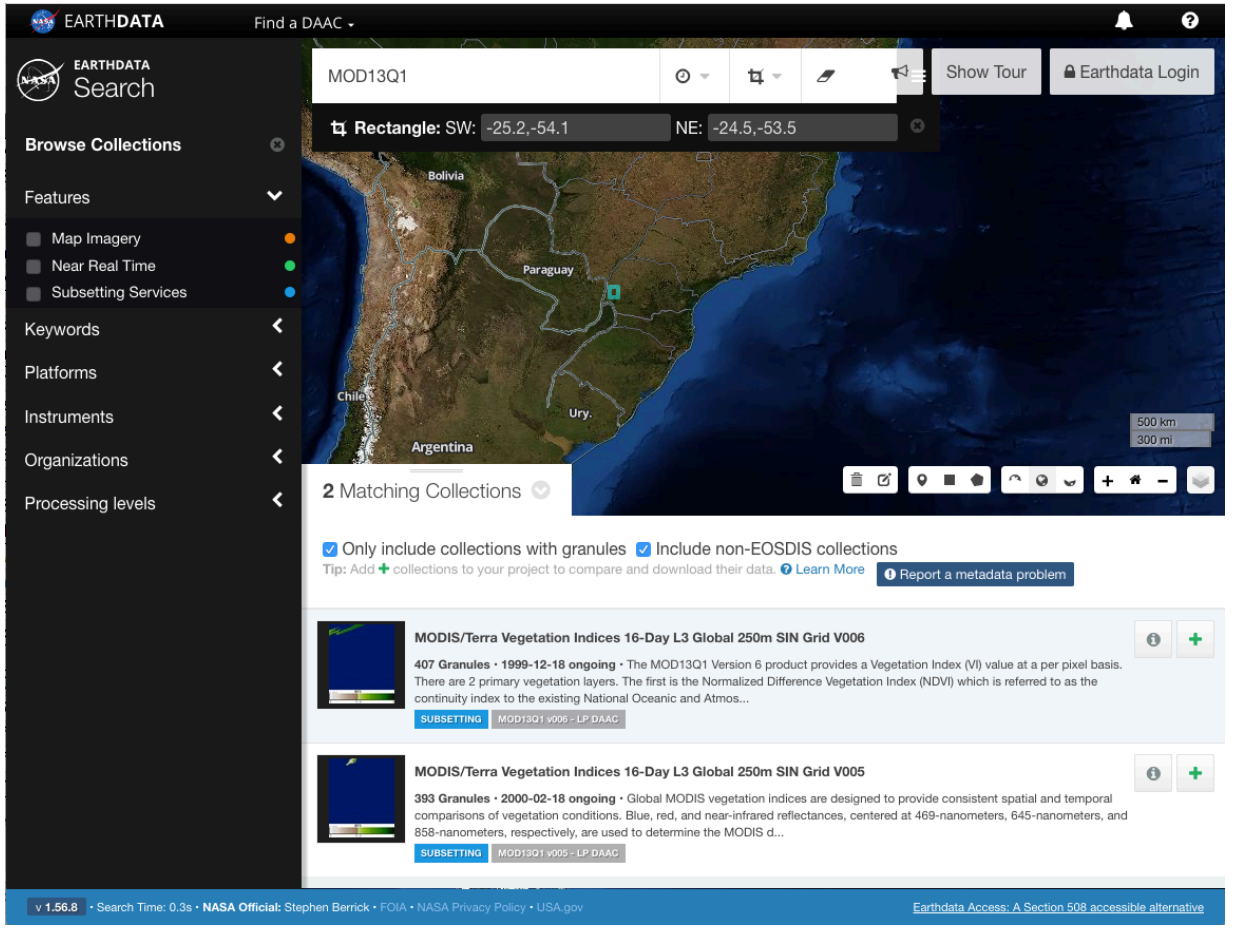




Search and Download NDVI Data

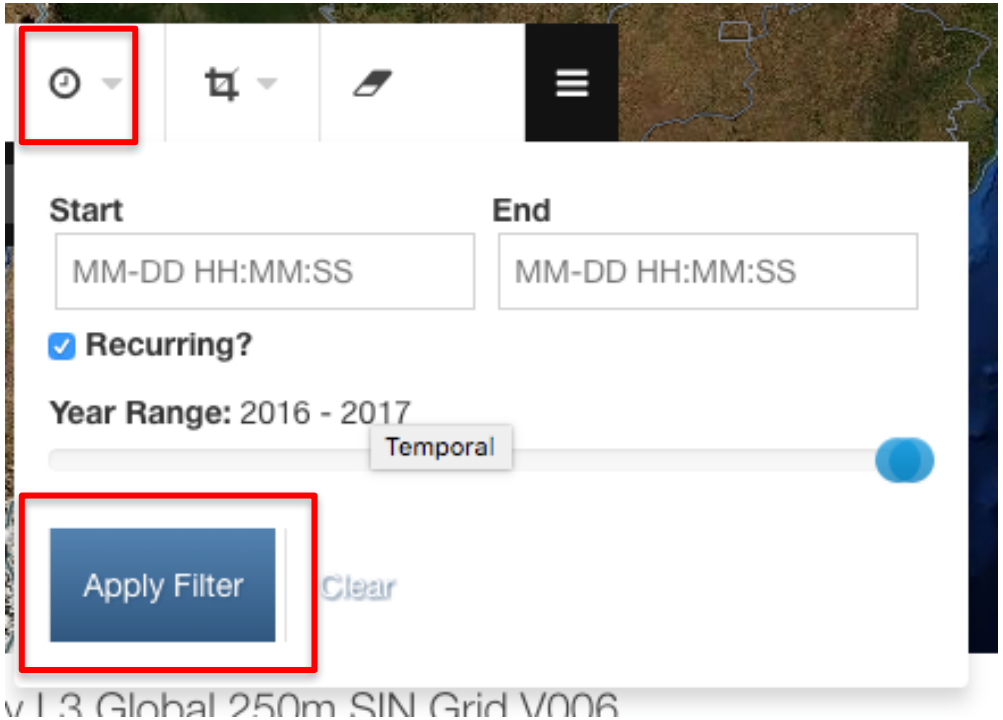
10. Click on **MODIS/Terra Vegetation Indices 16-Day L3 Global 250m SIN Grid V006** in the collections list
11. You will see available MODIS swath outline on the map





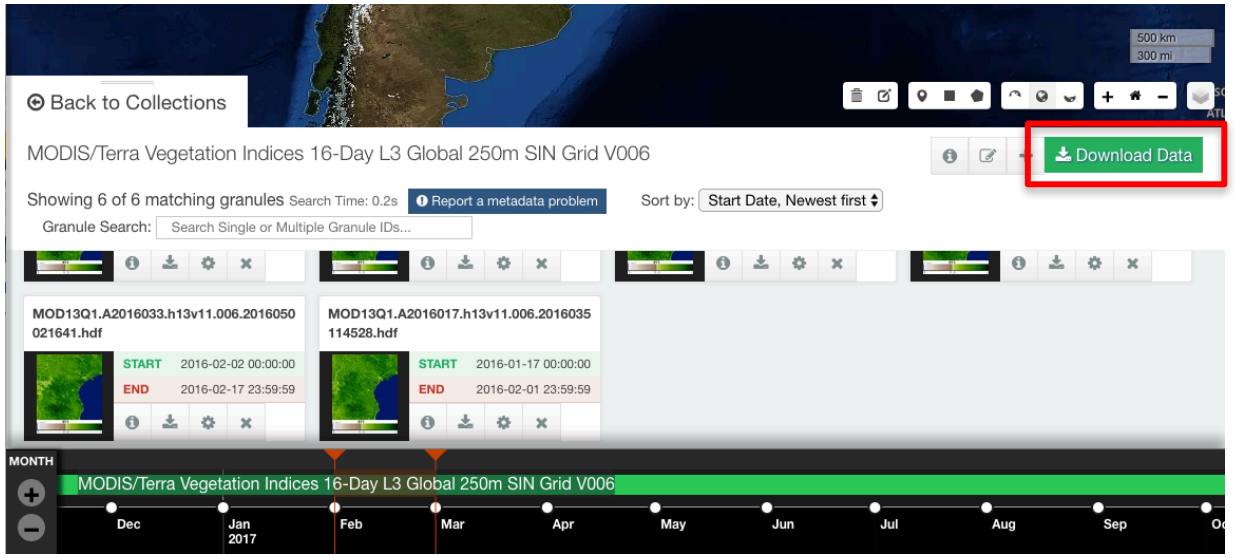
Search and Download NDVI Data

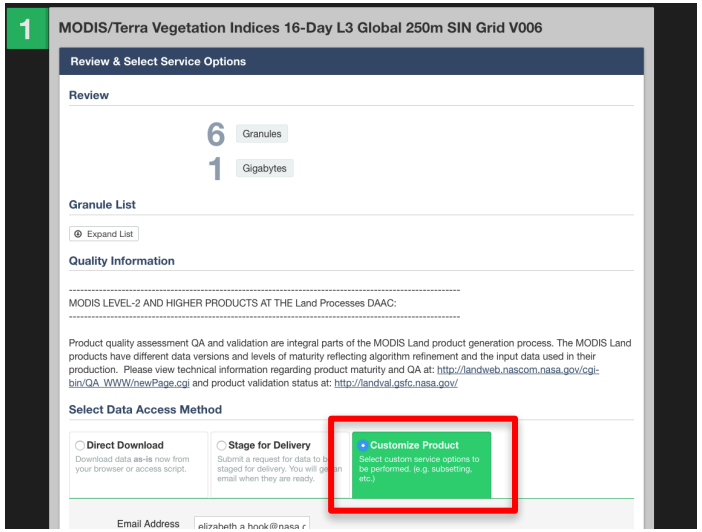
12. Click on the **Temporal** subset box
13. Check the **Recurring** box. This will provide a Vegetation Indices file for selected dates throughout the year range and will exclude all other dates
14. Move the blue circle under Year Range so that 2016-2017 is displayed
15. Put your cursor in the **Start** box, then select February, February 1
16. Put your cursor in the **End** box, then select February, then February 28
17. Click **Apply Filter**



Search and Download NDVI Data

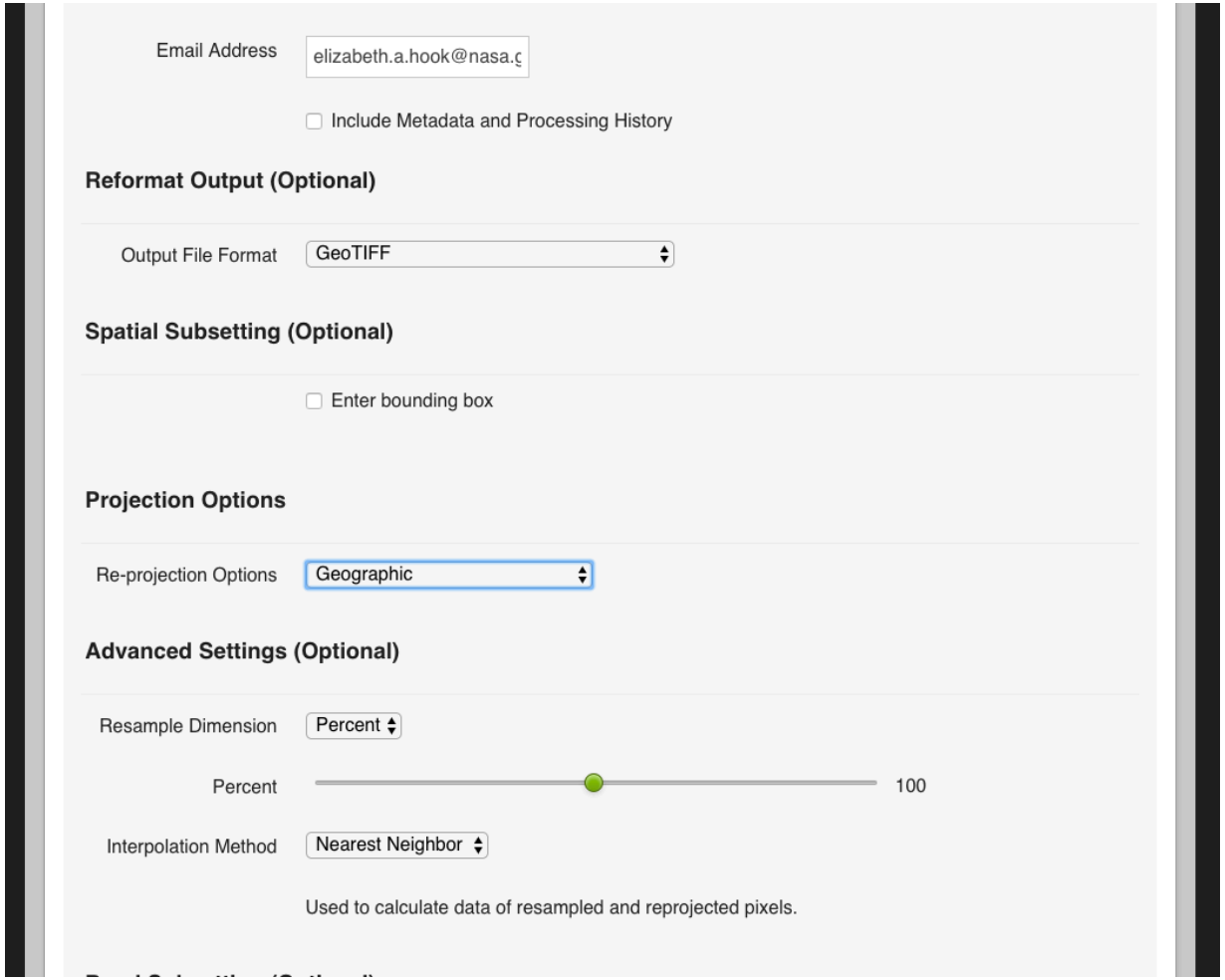
18. You will get a list of six MODIS NDVI swaths available for the selected periods
19. Click on the **Download Data** button on the right
    - You will be directed to the **Data Access** page. You can select specific options for your data type and delivery method
20. Under **Select Data Access Method**, choose the **Customize Product** option





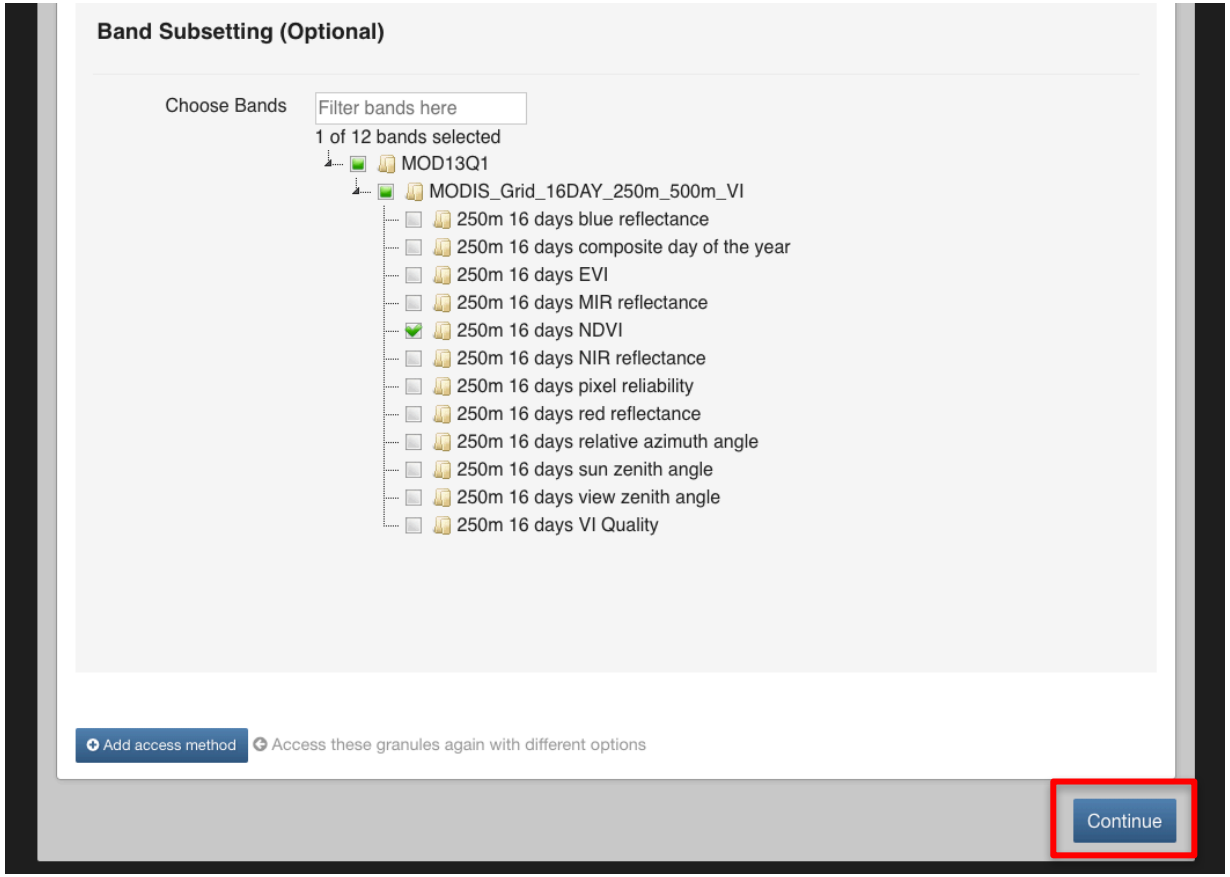
Search and Download NDVI Data

21. Confirm that your email address is correct
22. For **Reformat Output (Optional)**, select **GeoTIFF**
23. Leave **Spatial Subsetting (Optional)** unchecked
24. Under **Projection Options,** set **Reprojection Options** to **Geographic**
25. Leave the default **Advanced Settings**



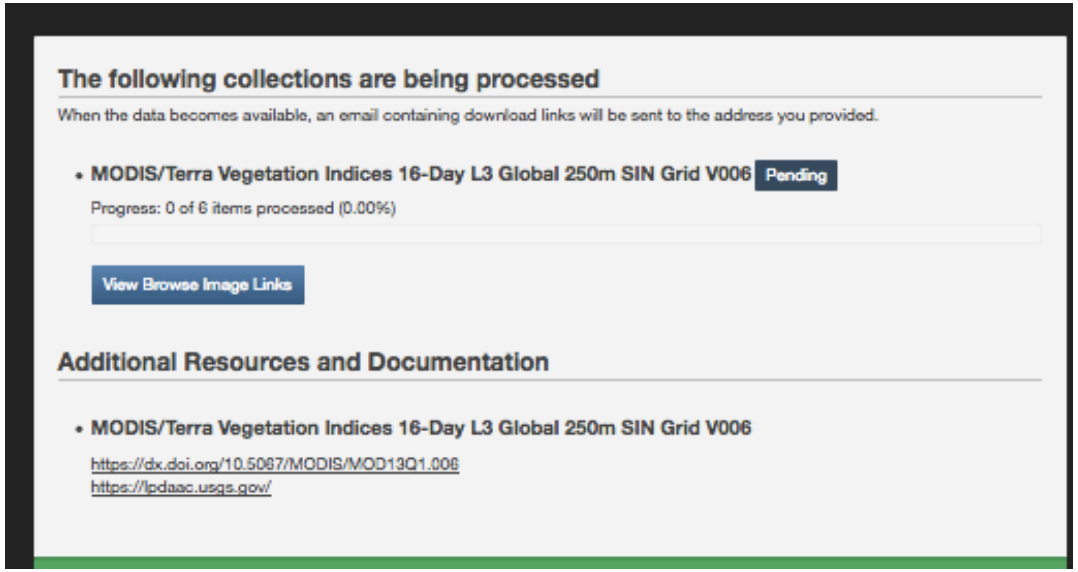
Search and Download NDVI Data

26. Under **Band Subsetting (Optional)**, click the arrow next to **MODIS_Grid_16DAY_250m_500m_VI**. This should display all bands, or products, available.
    - We are only interested in downloading the **250 m 16 days NDVI** option. Uncheck every other band option
27. Click **Continue** on the bottom right

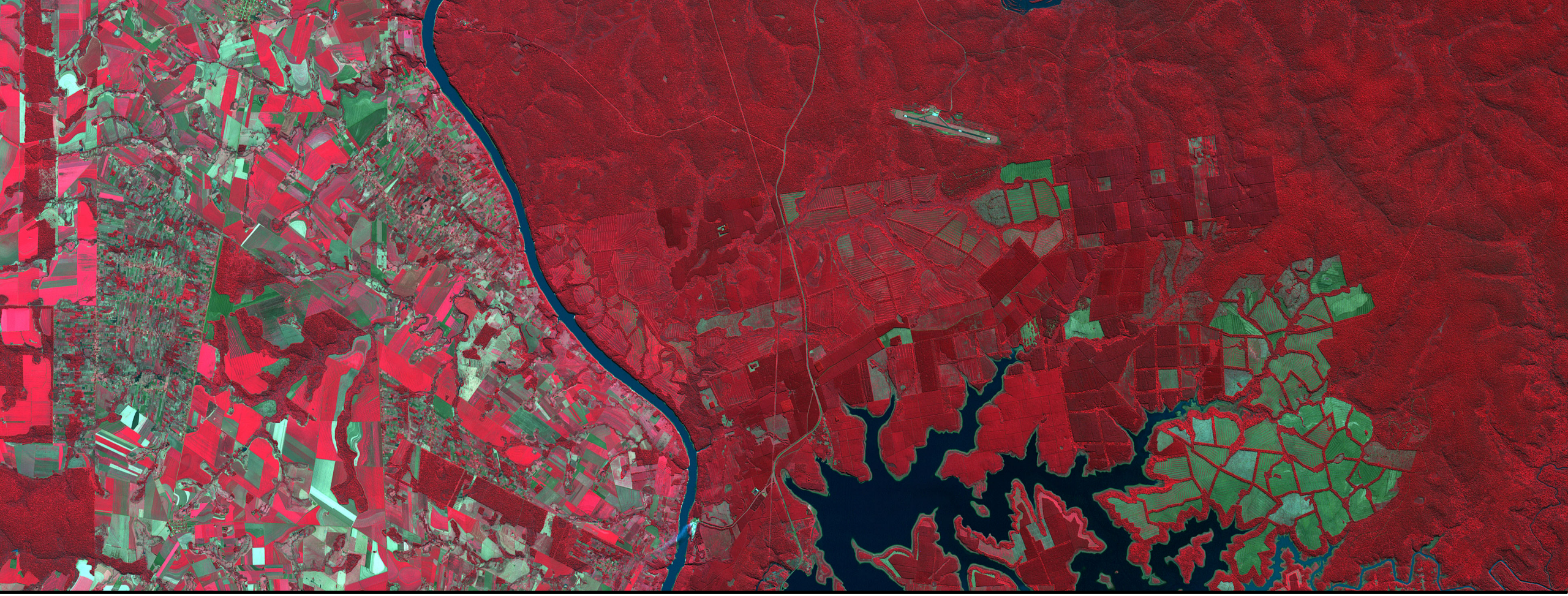


Search and Download NDVI Data

28. Review your contact information on the next page and click **Submit**
29. Your data download will begin to process. **Keep this page open.** You will be sent an email when the processing is complete and you will be provided with a direct download link
30. Once the processing is complete, click on the .zip file and save it to your computer
    - You should be provided with a folder and a .tif file for each year-month-date selected



31. At this point, you can copy the same NDVI data from the training USBS drive and save the data on your computer in a folder labeled **NDVI**



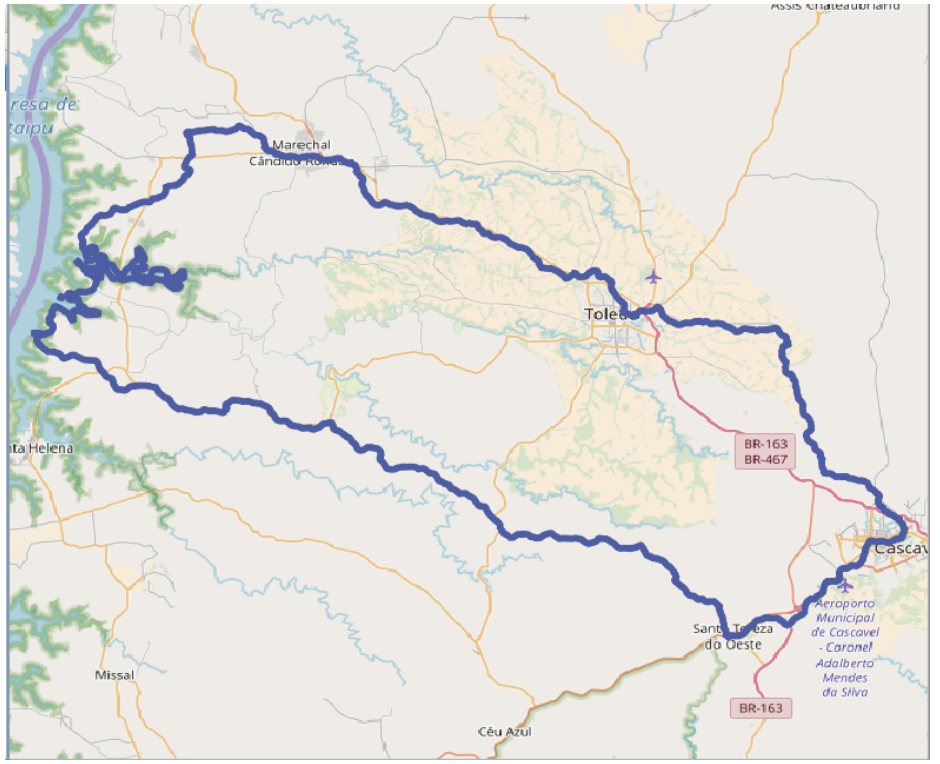
Part 2: Analyze Inter-Annual Differences in NDVI Using QGIS

Analysis of NDVI Using QGIS

1. Open QGIS and start a new project
2. From the top menu, click on **Web**, select **Open Layer Plugin** and select the background map **OpenStreetMap**
3. Click on the menu on the left bar and click **Add Vector** to add the SFV shapefile: sfv_4326.shp
4. To make the shapefile transparent with only the border left, right click on the layer file and go to **Properties** > **Style**
5. Click on the down arrow in the Fill window and select **Transparent fill**
6. Click on the down arrow in the **Outline** window and choose a color of the shapefile boundary (This example uses purple)
7. Set the **outline width** to be 2.0

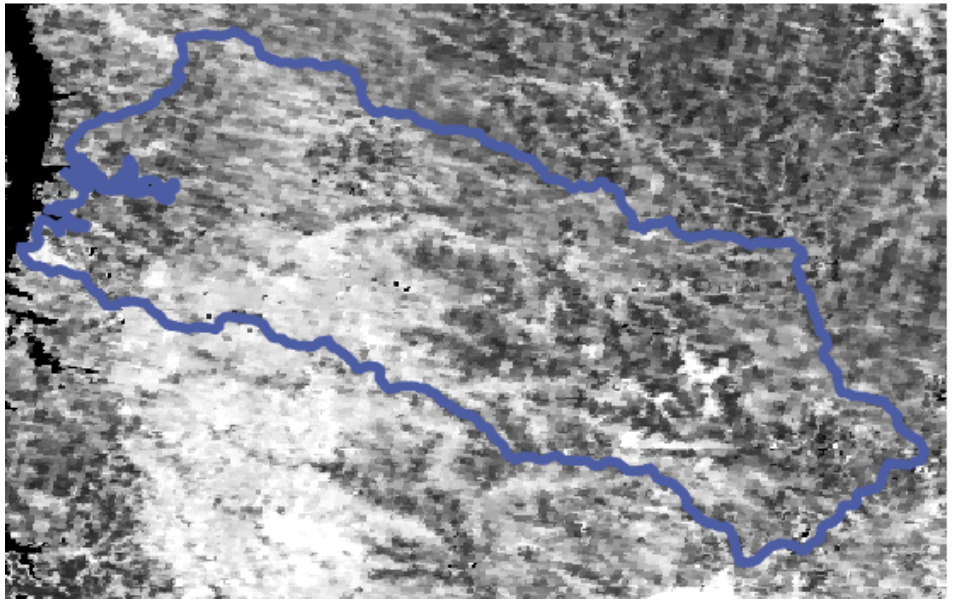
Analysis of NDVI Using QGIS

8. Click **OK** to get the following result in the QGIS window
9. Next Navigate to the NDVI folder and change the file names to make them short for convenience. For example: **MOD13Q1_A2016033_h13v11_006_2016035114528_MODIS_Grid_16DAY_250m_500m_VI_250m_16_days_NDVI_2c47e848** can be renamed **NDVI-2016033**



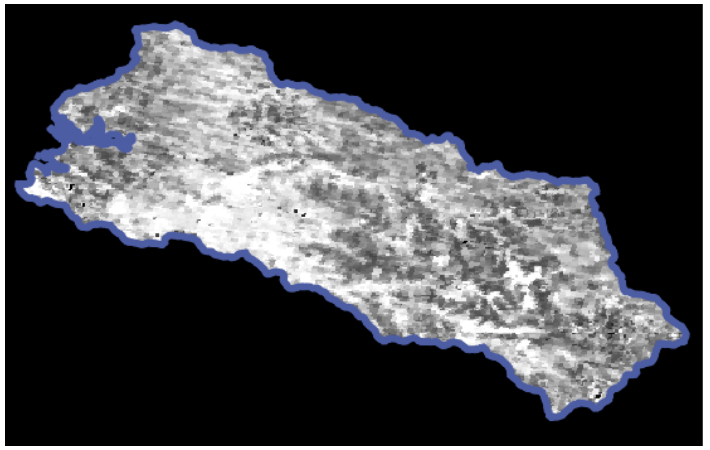
Analysis of NDVI Using QGIS

10. Click on the **Add Raster** function on the left and add NDVI-2016033
11. On the top bar go to **Raster** > **Extraction** > **Clipper** to open the Clipper options window
12. You will see **Extent** selected in the window
13. Enter **Output file** name by clicking on **Select** (Suggestion: **Temp1.tif**)
14. Drag the cursor across the map so that just the area around the shapefile is covered
15. You will then see the rectangular clipped layer on the map



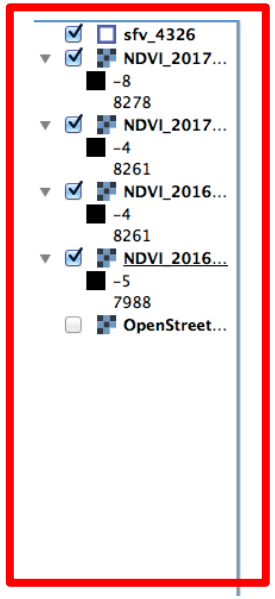
Analysis of NDVI Using QGIS

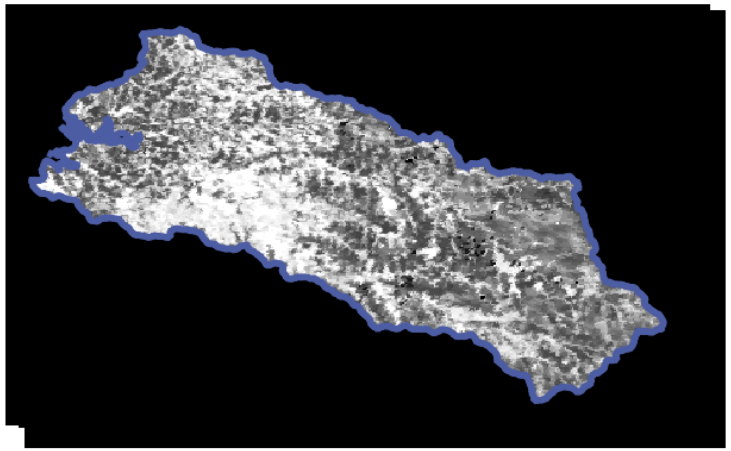
16. Clip the pre-clipped layer to the SFV shapefile
17. On the top menu, go to **Raster** > **Extraction** > **Clipper** to open the Clipper options window
18. In the Input File (raster) window, select the rectangular, clipped file **Temp1**
19. In the output file window, select output folder and enter a file name (Suggestion: **NDVI_2016033-Clipped**)
20. Check the **Mask Layer** and in the **Mask Layer** window select the shapefile named **sfv_4326**
21. Click **OK** on the bottom right
    - You should see the data clipped by the shapefile



Analysis of NDVI Using QGIS

22. Repeat Step 10 for raster layers: NDVI_2016049, NDVI_2017033, NDVI_2017049
23. Repeat steps 11-21 with the two-step clipping of newly added raster layers, first with a rectangle and then using the shapefile
24. Save the final, clipped files as NDVI_2016049-clipped, NDVI_2017033-clipped, NDVI_2017049-clipped
25. Remove all NDVI layers other than the final clipped layers





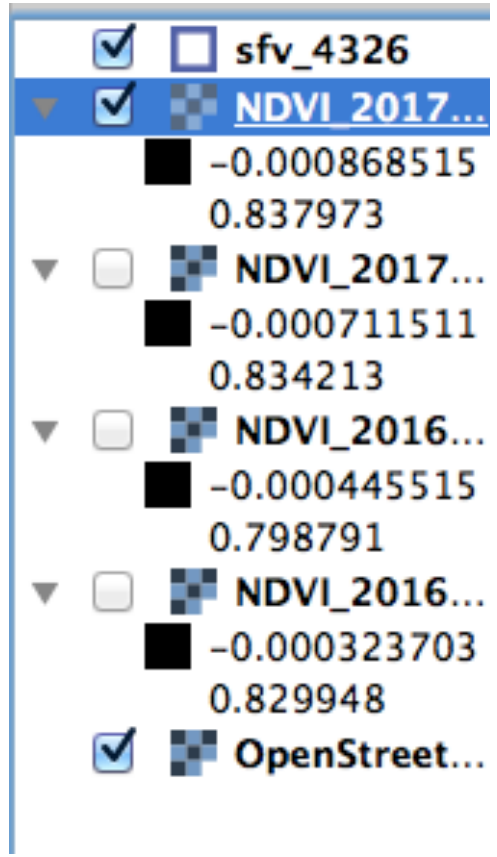
Analysis of NDVI Using QGIS

Notice that the NDVI values in these layers are not within -1 and 1. The data has to be scaled by 0.0001. This is the scaling factor for MODIS images.

26. Along the top of your QGIS map, go to **Raster** > **Raster Calculator**
    - This function allows you to perform specific, mathematical expressions to your raster layers
27. In the box on the top left, double click on the **NDVI_201633-Clipped@1** layer in the **Raster bands** to move that layer into the **Raster calculator expression**
28. Click on the multiplication function (*****) and Type in **0.0001**
    - The formula should look like: **"NDVI_2016330Clipped@1" * 0.0001**

Analysis of NDVI Using QGIS

29. Give it an output name (Suggestion: NDVI_2016033-Scaled) in the **Output layer box**
30. Click on the button with 3 dots next to the box to ensure that you save your image to the correct folder
31. Leave all other settings as default, and make sure that the **Add results to project** box is checked. Click **Ok.**
32. Repeat steps 26-29 to scale all the NDVI layers
33. You will now see values between -1 to 1



Analysis of NDVI Using QGIS

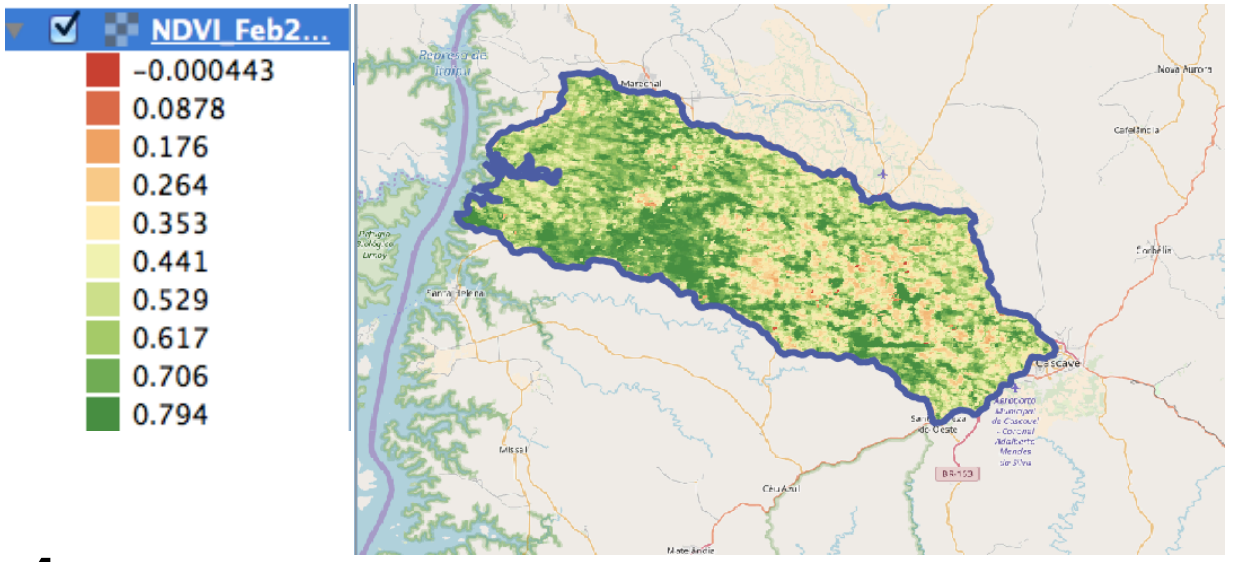
Next, calculate the average NDVI for February 2016 by adding the two raster layers (003 and 049)

34. Click on **Raster** > **Raster calculator**
35. Click on **(** in the **Operators** window and then double click on the **NDVI_201633-Scaled@1** raster layer in the **Raster Band** window
36. Add a **+** and double click on **NDVI_2016049-Scaled@1** and then add **) * 0.5**
37. You will get the following **Raster calculation expression**: ("NDVI_2016033-Scaled@1"+"NDVI_2016049-Scaled@1")*0.5

Analysis of NDVI Using QGIS

38. Name the **Output Layer** as NDVI-Feb2016
39. Click Ok to get the NDVI for 2016
40. Repeat the raster calculation for February 2017 following Steps 36 and 37
41. You may want to remove all NDVI other layers other than the NDVI_Feb2016 and NDVI_Feb2017
42. The NDVI images are currently in black and white. As you recall, NDVI values range from 0 to 1, with 0 having no vegetation and 1 having the highest density vegetation. Generally, a good way to view an NDVI image is with a color ramp ranging from red (low NDVI values) to green (high NDVI values).

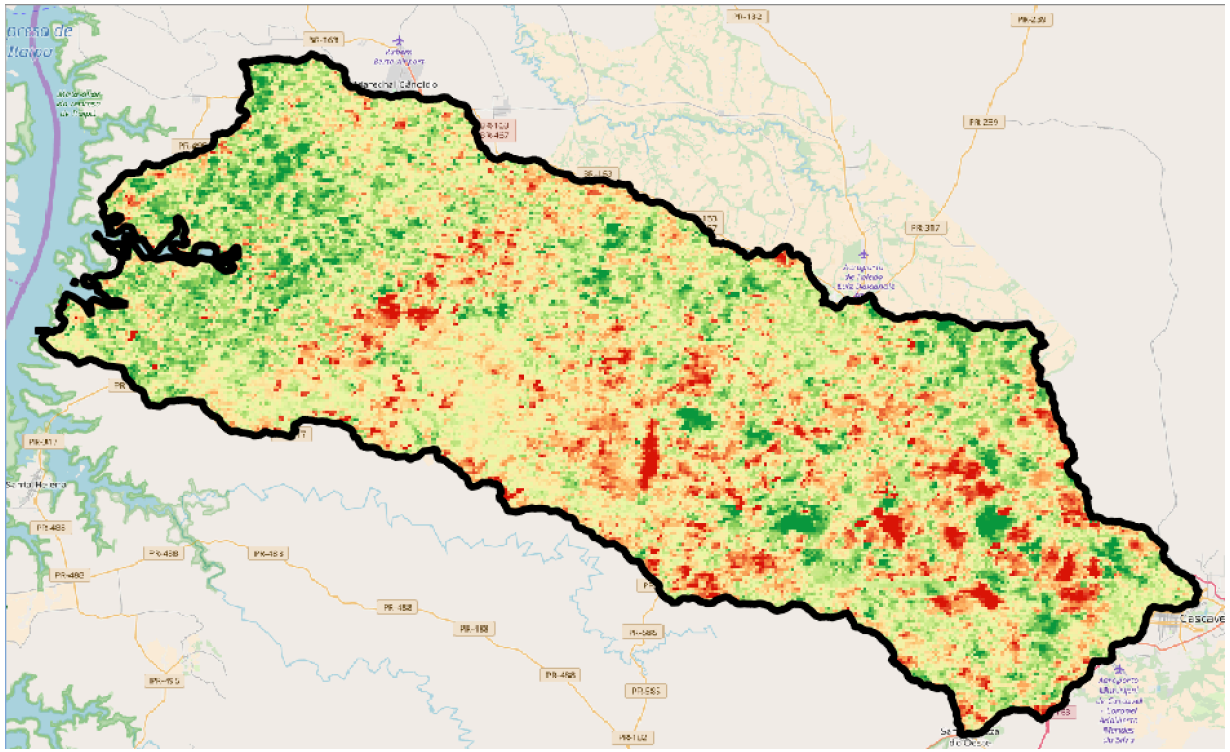
Analysis of NDVI Using QGIS



43. Click on NDVI_Feb2016, and select **Properties** > **Style**
44. Set the **Render Type** to be **Singleband Pseudocolor**
45. Under **Color,** set the color palette to be Red to Green (**RdYlGn**)
46. Set **Min** value to 0 and **Max** value to 1
47. Below the color display, change the **Mode** to **Equal Interval** and **Classes** to 10
48. Click **Classify**, **Apply,** and **OK**
49. Repeat steps 43-48 for NDVI_Feb2017

Inter-Annual Difference of NDVI

50. Take the difference of the NDVI by using **Raster** > **Raster Calculator**
51. Use the following expression to subtract the February 2017 NDVI from February 2016:
    - **"NDVI_Feb2016@1" – "NDVI_Feb2017@1"**
52. Name the Output Layer **NDVI_Difference**
53. Click **Ok** to get the difference
54. Color the image by following steps 43-48 for the **NDVI_Difference** layer



Discussion Questions

1. Examine the NDVI maps of February 2016 and 2017. Which year shows more green vegetation?

2. Compare the NDVI maps with the Landsat Tree Cover Map from the previous exercise – do you see any similarity? Explain.

3. Examine the NDVI difference map. What are the regions where the NDVI differences are large (showing excess and deficit)?

4. For what applications would you use NDVI?